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# Catfish Farming

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# Catfish Farming

Catfish farming is an important agricultural industry in the United States, with more than 60,000 acres of water devoted to catfish production. These catfish are being grown under several production systems and with various degrees of management. Successful catfish farming generally requires constructing facilities; controlling water quality; rearing, stocking, and feeding fish; and harvesting and marketing the fish crop.

A fish farmer must decide what type of catfish farming enterprise to establish based on the desired level of fish production and the availability of capital, land, and water resources. The size of the fish farming operation and the farmer's commitment to management will determine the efficiency and profitability of the enterprise. Catfish farming may provide a major source of income, diversify an existing farming operation, or satisfy family food and recreational needs.

A fish farmer can grow catfish in ponds, cages, or raceways. The fish can be marketed in several ways—as small fish for stocking, as pan-size fish for food or recreational fishing, or as large fish for brood stock.

Careful planning is an important part of any operation. A well-designed catfish farm is the result of proper planning to suit individual needs. Catfish farm planning and application assistance is available from the Soil Conservation Service.

This bulletin discusses the production of channel catfish (fig. 1) (*Ictalurus punctatus*), the most commonly grown species. Other species, such as the blue catfish (*I. furcatus*) and the white catfish (*I. catus*), have similar cultural requirements. All three species grow well where water temperatures are above 70°F for at least 4 months each year. They are native to America and have a good conversion ratio of feed to flesh.



Figure 1.—Market-size channel catfish.

# Methods of Catfish Farming

## Ponds

Pond culture is by far the most common type of catfish production. Ponds can be installed on sloping upland valleys or on nearly level land. The number, size, and shape of ponds are often limited by soils, topography, and available water supplies. Catfish farms may range in size from 20 acres or less to 640 acres or more depending on available resources.

A catfish farm needs a water-distribution system, convenient drainage facilities, complete protection against floodwater, and a system of all-weather roads. Careful attention to pond size and design, elevation of drainpipes, and adequacy of outlets and spillways is important.

The earth-fill levee or dam is probably the most expensive item of construction when a catfish pond is installed. The design of the dam or levee depends on the site selected. The watershed or drainage area, the height of the dam, the need for a roadway along the top, and the soil under the dam, as well as the soil material to be used in the dam, must be considered. Dams are built of soil material excavated from inside or outside the pond area, or both. Soils in certain locations are unsuitable for catfish ponds because of their low water holding capacity and/or cavernous conditions underneath the pond. The side slope of the dam or levee must be able to withstand erosion from the wave action. All trees, stumps, and brush should be removed from the water area. Smooth the bottom and gradually slope it to the harvesting area. Establish grass cover on dams and levees.

Do not locate ponds on land where pesticides have been regularly applied to crops, especially to cotton. If there is any question concerning pesticide residues, have the soils tested.

An overflow pipe (fig. 2) is needed to discharge runoff water and prevent loss of fish through the emergency spillway. This pipe establishes a stable waterline and allows temporary storage to be accumulated and disposed of without excessive use of the emergency spillway. To prevent a loss of fish through the overflow pipe, place around this pipe a sleeve of larger pipe that extends up to the level of the emergency spillway. This sleeve acts as a trash rack and allows deeper water containing less oxygen to be discharged (fig. 3). If runoff water periodically enters a pond, a properly designed spillway is needed. When water flows through a spillway, catfish may swim out of the pond. To prevent losing fish, the spillway must be wide enough that the flow is less than 3 inches deep. A screened overfall (fig. 4) installed in the spillway keeps undesirable fish from entering the pond from downstream.



*Figure 2.—A turndown drainpipe can be adjusted to regulate the water level in a pond. When the pipe is upright it keeps the pond full, when turned down it drains the pond.*

## **Cages**

Cage culture of channel catfish represents only a small fraction of the total farm-raised catfish production. Although cage culture has limited popularity, it has potential in bodies of water where conventional harvesting methods are impractical.

Catfish cages (fig. 5) are made of vinyl-coated or corrosion-resistant wire on wood or metal frames with a hinged door on the top for feeding and harvesting and are floated by styrofoam blocks. Place in open water and anchor to posts or cables. The cage bottom should be 2 to 3 feet above the pond bottom. The number of caged fish per pond depends on the overall carrying capacity of the pond and its

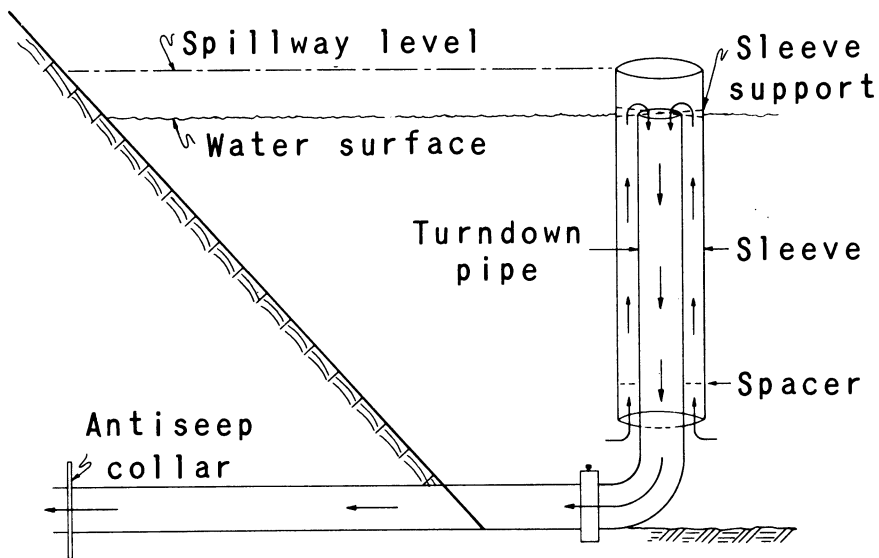


Figure 3.—A bottom-water release allows oxygen-deficient water to be discharged.

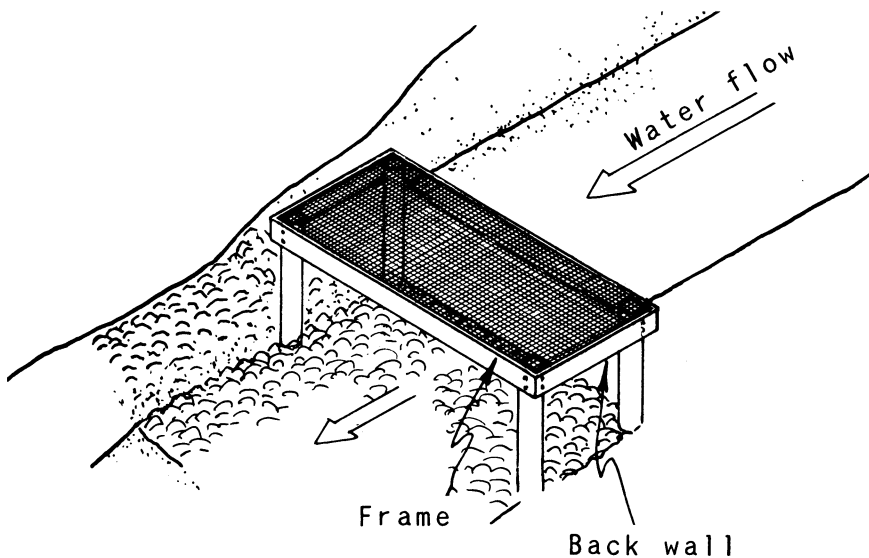


Figure 4.—A screened overfall in the emergency spillway helps keep unwanted fish from entering the pond.



*Figure 5.—Floating cages make catfish production and harvest possible in ponds with irregular shapes and depths and varying bottom composition.*

water quality and quantity. The amount of fish produced in cages will be about the same as in traditional open pond culture.

Recent studies of catfish cage culture indicate that 7- to 8-inch fingerlings are ideal for stocking in cages at the rate of eight or nine fish per cubic foot during late March or early April. Since natural food is not available to the fish, a nutritionally complete, floating feed must be used. To ensure circulation of water, scrub the outside of the cages regularly to remove accumulations of algae and debris. Monitor the oxygen content of the water. Check fish regularly for diseases and parasites because fish are under greater stress in cages than in ponds. Diseases and parasites are easily transmitted among fish grown in high density and confined environments.

Because of the unique management requirements for catfish cage culture, study current research findings and reference publications before attempting to use this method.

### **Raceways**

A fish raceway system (fig. 6) especially designed for fish production consists of a series of long, narrow channels through which there is a continuous flow of water. Raceway systems are widely used for trout production, but their use in commercial catfish production has been limited.





*Figure 6.—Earthen and concrete raceways historically used for salmonid production are finding a place in commercial catfish operations in some regions.*

Raceway culture of channel catfish requires more intensive management than pond culture. The complex design and operation of a raceway system should be undertaken only with professional guidance. Serious handicaps to raceway culture are the higher requirements for water quantity and quality. Also, energy cost is high where water must be continually pumped through the system. Because of these limitations, economically successful catfish raceway systems have been restricted to areas having large quantities of relatively inexpensive high-quality water.

# Key Factors in Catfish Farming

## Water Source

Because a dependable supply of good-quality water is essential for catfish farming, the availability of water is a key factor in determining the feasibility of any fish farming operation. Water from wells, springs, streams, and runoff ponds is suitable if necessary precautions are taken. Regardless of the source, the supply of available water will dictate fish farm management strategies and determine the maximum potential for fish production.

The best source of water is a well (fig. 7). Use of well water avoids problems of unwanted fish, flood hazard, pesticides, and muddiness. Water from wells is measured in gallons per minute (gpm) and pond volume is measured in acre-feet. An acre-foot is 43,560 square feet 1 foot deep and contains 326,000 gallons of water. Thus, a 1,000-gpm well yields 4.4 acre-feet in 24 hours.

The well yield determines the size of an enterprise. Wells should provide enough water to fill the ponds, replace water lost through evaporation or seepage, and maintain water quality suitable for fish growth. Under intensive management and maximum production, these water requirements can usually be met with a well supplying 1,500 gpm for each 40 surface acres of ponds (37.5 gpm/surface



*Figure 7.—A well provides the clean water needed for fish farming.*

acre). Fish farming operations using less water are practical at lower levels of fish production. Where underground water sources are unknown or questionable, drill a test well.

Well water often has excessive dissolved carbon dioxide but no oxygen—a combination deadly to fish. Disperse harmful gases and oxygenate the water by splashing the flow over baffles or through coarse screens or by spraying the water through the air before it enters the pond. A fall of 4 or 5 feet is enough to make the water safe.

Water from springs and watershed runoff are also acceptable sources if sufficient quantities are available. Determine the adequacy of spring water sources during the low-flow conditions of dry seasons. Ponds dependent on runoff water should have watersheds large enough to supply the needed water volume.

Water taken from a pond, stream, bayou, canal, or other surface source usually contains undesirable fish that will get into ponds and compete with catfish. The only known way to remove fish and fish eggs satisfactorily is to pass the water through a 100-mesh saran or fiberglass screen filter (fig. 8).

## **Water Quality**

Water quality includes all physical, chemical, and biological factors that influence the beneficial use of water. Maintaining good water quality is vital to successful catfish farming. The survival, reproduction, growth, and management of fish are all affected by water quality characteristics. SCS conservationists, county agents, and state or federal biologists can assist in the determination of water quality.

Significant water quality characteristics include pH, total hardness, total alkalinity, dissolved oxygen, and temperature. The desirable pH is between 6.5 and 8.5. If the pH is below 7.0 and the total hardness and total alkalinity are less than 10 ppm, add agricultural limestone based on soil tests by your state soils laboratory.

Dissolved oxygen is a critical water quality characteristic in fish farming. Dissolved oxygen concentrations of 5 ppm or higher are most desirable for catfish production but successful catfish operations are possible by maintaining oxygen concentrations of 4 ppm. Fish may survive oxygen concentrations as low as 0.5 ppm for short periods, but prolonged exposure to such low oxygen levels will result in fish kills or poor growth.

Oxygen may be low at any time of the year, but serious deficiencies are most likely when there is a combination of high temperature, little wind, decaying organic materials, and cloud cover for several days. Summer thunderstorms with strong winds may cause a pond to “turn over”—mixing oxygen-deficient water from the pond bottom



*Figure 8.—A filter of saran or fiberglass keeps unwanted fish and fish eggs out of the pond.*

with surface water, and thus depleting the oxygen supply. In winter, oxygen may be low when ice and snow cover the pond.

Water temperature affects fish growth. If properly fed, catfish grow rapidly when the water temperature is between 75° and 85°F. Growth is slower between 60° and 70°F, and little growth occurs when water temperature is below 60°F.

In the South, deep water is not necessary for catfish farming. On flat land, excavate ponds or construct levees to impound water to a depth of about 2½ feet at the shallow end and 5 or 6 feet at the harvesting basin. Ponds depending on runoff for their water supply must be deep enough to carry catfish through a drought. Farther north, a depth of 8 feet or more may be necessary to prevent winterkill.

## Operating a Catfish Farm

### Catfish Spawning

For a small operation, a farmer usually buys fingerling fish (2 to 10 inches long) for stocking. However, for large fish farms the farmer usually keeps brood fish and operates a hatchery to provide fingerling catfish for stocking ponds. In some areas, certain farmers specialize in the spawning, hatching, and production of fingerling catfish for sale and are not involved in the production of large fish.

The facilities needed for producing large numbers of fingerling catfish include holding ponds for brood fish, spawning ponds, hatchery building with paddlewheel troughs and holding vats (fig. 9) or tanks, and rearing ponds for young fish.

The facilities actually required will vary depending on the size of the operation and methods used in hatching eggs. Hatchery buildings equipped with paddlewheel troughs require electricity and a good supply of water.

Channel catfish brood stock should be at least 3 years old. Larger females produce more eggs than smaller ones, but fewer per pound of brood fish weight. Larger females (8-15 lbs) usually lay about 2,000



*Figure 9.—Holding vats are used for grading fingerlings, holding fish for retail sale, treating fish to control disease, and for holding brood fish.*

eggs per pound of body weight, medium size females (5-7 lbs) 3,000 eggs per pound, and small females (3-4 lbs) 4,000 eggs per pound. Keep breeders in holding vats, separated by sex, except during the spawning season. Feed them all the pellets they will eat each day and stock forage fish such as fatheads, golden shiners, goldfish, or other species to provide animal-protein food.

To prevent contaminating your farm, obtain only healthy, parasite- and disease-free brood fish. Introduce new brood stock every few years to maintain vigor and productivity and to reduce in-breeding.

Catfish usually start spawning in the spring when the water temperature has been at least 70°F or higher for 3 or 4 days. The peak of the spawning season occurs during a 15- to 20-day period when water temperature is 78° to 82°F. Spawning ceases if the water temperature drops below 70°F, but resumes when the water warms. Frequent cold periods during the spawning season are detrimental.

Catfish eggs are more easily found if wooden boxes (fig. 10), milk cans, kegs, tile, hollow logs, barrels, or similar devices are placed in the pond for spawning sites. Paint metal containers with asphalt paint and anchor them to the bottom at depths of 2 to 4 feet.

Individual pairs usually start spawning about daybreak, with the female depositing eggs and the male immediately fertilizing them. This spawning act is repeated every 6 to 8 minutes until the female



*Figure 10.—Boxes are good spawning devices. Cans, smooth tile, or other containers are also suitable.*

has finished laying. The eggs are adhesive and stick together, forming a mass in the bottom of the nest. The male guards the eggs and fans them almost continuously for 6 to 10 days until they hatch.

There are two methods of spawning brood fish, open pond spawning and pen spawning. Open pond spawning is the easier and requires less experience and facilities. Stock 10 to 20 pairs per surface acre in the spring when temperature reaches 65°F. Use lower stocking rate if the young fish are left in the pond with the brood fish until they reach fingerling size. Feed them pelleted catfish food at 3 percent of their body weight per day. Provide at least one spawning nest for each pair of brood fish. Nests should be placed in water 2 to 4 feet deep and 10 to 20 yards apart.

Pen spawning (fig. 11) in ponds requires more handling of brood fish and is best suited to experienced farmers specializing in fingerling production. Provide an individual pen (5 x 10 ft) with a nest for each pair of brood fish. Heavy-duty vinyl-covered wire with 2-inch mesh and creosote- or pentachlorophenol-treated wooden posts or steel posts are desirable materials for use in constructing pens. Build the



*Figure 11.—Pen spawning requires special facilities but makes managing and monitoring brood stock and collecting spawn easy and efficient.*

pens along the pond bank extending into 2 feet of water with wire embedded in the pond bottom. As many as 20 pens in a ¼-acre pond have been satisfactory. Check nests every 2 or 3 days for egg masses and remove females after laying. After egg masses or fry (newly hatched fish) are removed, stock another female. Repeat this cycle until the spawning season ends. Large males in good condition will successfully spawn with two to eight females during one spawning season, but females spawn only once each year.

**Handling Eggs and Fry.** There are several methods of handling eggs and fry. Each method has advantages and disadvantages, and the best method will depend on experience, labor, and facilities available.

(1) Allow the eggs to hatch in the nest and leave fry in the brood or hatching pond until they reach fingerling size (2 inches or larger) and are ready for transfer to production ponds. Feed them sinking catfish feed each day. If practical, remove the brood fish after the peak of the spawning season to prevent them from eating young catfish and from transferring parasites and diseases to the fingerlings.

(2) Leave eggs in the nest until they hatch. Move the fry 1 to 3 days after hatching to separate rearing ponds and feed them daily until they reach fingerling size.

(3) Move the eggs from the nests and place them in a paddlewheel hatching trough (fig. 12). By separating fry from the brood fish, this method prevents the spread of parasites and diseases. In pen spawning, it also allows the farmer to replace each female that has spawned with another female, and get several spawns from each pen. Paddlewheel hatching troughs are built of fiberglass, marine plywood, metal, or wood and are about 20 inches wide, 10 inches deep, and 10 feet long. They are usually operated by electric motors but may be powered by a water wheel. Place egg masses in wire baskets made of ¼-inch hardware cloth; six or more baskets of eggs can be placed in each hatching trough. Run 3 to 5 gpm of aerated water, preferably at 78° to 82°F, through the troughs. The paddles operate at 20 to 40 revolutions per minute (rpm) and keep the water moving around the eggs much as the male catfish does by fanning the egg mass with his fins.

Transfer the fry within 24 hours after hatching by siphoning from the hatching trough into a screened container. Estimate the number of fry by measuring water displacement in a household measuring cup. About 1,000 1-day-old fry will displace 1 ounce of water. Hold fry in screened boxes placed in tanks or vats with running water (5 to 7 gpm) for 4 or 5 days, at which time they will begin feeding on tiny particles of crumbled catfish pellets. Holding vats are built of wood, galvanized metal, concrete blocks, poured concrete, or glass bonded





Figure 12.—Paddlewheel hatching troughs simulate “fanning” performed by adult males.

on steel. These vats are essential for use in grading fish into size classes, for holding fish for sale, for temporary storage, and for treating fish to control parasites. A vat 30 feet long, 4 feet wide, and 3 feet deep is a practical size. The inside of concrete vats must be smoothed or painted with asphalt or epoxy paint. Holding vats require clean water with oxygen content of at least 5 ppm; water containing more than 1 ppm of iron must be aerated or filtered before being used. Transfer fry from the holding vat to rearing ponds to grow until they reach fingerling size.

**Growing Fingerlings.** Catfish fry grow faster and have fewer parasites and diseases if removed from the brood pond and stocked in rearing ponds where no other fish are present. Make every effort to keep rearing ponds free of other species. Use saran socks or other filtering devices if the water supply is infested with fish, and use vertical drops on spillways to prevent fish from swimming up the spillway discharge and entering the pond.

The size of catfish fingerlings at the end of the first growing season in the fall is controlled mainly by number of fry stocked per acre and rate of daily feeding (table 1). Fry stocked at 20,000 per acre and given proper feeding will reach an average size of about 6 inches by October. Stock 40,000 fry per acre if 4-inch fingerlings are needed

and 10,000 per acre if 8-inch fingerlings are desired. At any stocking rate, fingerlings will vary considerably in size at harvest. Size variation is less when rearing ponds are completely stocked with fry of the same age on the same day.

Table 1.—Average length and weight of 1- to 2-inch fingerlings at end of first 180-day growing season

Number stocked per surface acre	Fish <sup>1</sup>	Total weight of fish	Average weight per 1,000 fish	Average length of fish
	<i>Number</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Inches</i>
40,000	30,000	600	20	4
30,000	22,500	720	32	5
20,000	15,000	900	60	6
15,000	11,250	1,050	93	7
10,000	7,500	840	112	8
5,000	3,750	675	180	9

<sup>1</sup> A 25-percent loss is assumed.

## Stocking Production Ponds

Fish are grown from fingerlings to eating size by daily feeding in production ponds. These ponds range from less than 1 acre to more than 100 acres. In an ideal growing season, fingerlings stocked in early spring will reach eating size by autumn.

The number and size of fingerlings stocked per acre will determine their size at the end of the growing season. Medium-size fingerlings (4 to 6 inches) stocked at 1,500 per surface acre usually average slightly more than 1 pound in a 210-day growing season. The same medium-size fingerlings stocked at 2,000 per surface acre average slightly less than a pound. Large fingerlings (10 inches long or weighing  $\frac{1}{3}$  pound) stocked at 1,200 per surface acre average about 2 pounds at the end of the growing season. If the growing season is shorter than 210 days, stock larger fingerlings or plan to hold the fish overwinter for harvest during the next growing season.

Catfish stocking rates vary from one farming operation to another, depending on available resources and the farmer's commitment to a specific level of management. Many commercial fish farmers provide intensive management and stock at rates of 3,000 to 4,000 fish per acre. Farmers applying lower levels of management should stock at rates considerably less than indicated above.

The following stocking rates are practical under varying levels of management:

(1) For home use fish production in impoundments that depend solely on runoff water, and if lift pumps are not available, stock 750 to 1,000 fish (4 to 6 inches) per surface acre.

(2) For commercial production under low levels of management in ponds having a sure water supply, stock 1,500 to 2,000 fish (4 to 6 inches) per surface acre.

(3) For intensive commercial production, stocking rates of 3,000 to 4,000 fish (4 to 8 inches) per surface acre are practical using high level management skills combined with adequate water supply and aeration equipment.

For proper stocking you must know the number of fish. It is impractical to actually count them, but you can determine the desired number on the basis of weight (table 2). This can be done in two ways: First, count the number of fish in a known weight. Example: If there are 100 fish in 1 pound and you want to stock 2,000 fish, weigh out 20 pounds of fish. Second, measure the length of the fish and use table 2. Example: Fish 3 inches long weigh 10 pounds per 1,000 fish. If you want to stock 2,000 fish, weigh out 20 pounds of fish.

Table 2.—Average length and weight of channel catfish

Length	Weight per 1,000 fish	Weight of individual fish
<i>Inches</i>	<i>Pounds</i>	<i>Ounces</i>
1	1.3	—
2	3.5	—
3	10	—
4	20	—
6	60	—
8	112	—
10	328	5.25
12	509	8.2
14	850	13.6
16	1,290	21

## Feeding

Good catfish feed contains 32 to 36 percent protein, 6 percent fat, 10 to 20 percent carbohydrates, and 10 to 15 percent fiber. A minimum of 8 percent of the ration should be from fishmeal and all feeds should contain the recommended vitamins. Ingredients used in making feeds vary widely, depending on availability and cost.

Feeds are sold as floating or sinking pellets and as finely ground meal or crumbles. Floating pellets cost more but are more stable than sinking pellets. They also enable you to determine whether the fish are feeding. If they are not feeding, find the cause and correct it. Some experienced fish farmers prefer sinking pellets because of the lower cost and they have learned to tell whether the fish are feeding normally by observing the activity of the fish in the feeding areas. There is little or no difference in fish growth between the use of

floating feeds and sinking feeds. Some farmers mix a small amount of floating pellets with sinking pellets so they can observe feeding activity more easily.

Fry should be fed as soon as they leave the nest or swim up in the holding vats or tanks. Meal or crumbles made from a good-quality catfish feed is used primarily for fry. Fry may take the feed more readily if a jar of baby food liver is added to each pound of meal or crumbles. In screened holding boxes, feed only as much as the fry will eat in 20 or 30 minutes. In ponds, feed 2 to 3 pounds per surface acre each day. Gradually increase the quantity of feed to the amount they will eat in 20 to 30 minutes. As the fry approach fingerling size and are feeding well, seine and weigh a sample of fish every 2 or 3 weeks and adjust the feed to about 3 percent of the total weight of fish in the pond.

Use  $\frac{1}{8}$ -inch pellets for fingerlings from 2 to 6 inches long,  $\frac{3}{16}$ -inch pellets for fish up to one-half pound, and  $\frac{3}{8}$ -inch pellets for larger fish. Pelleted catfish feeds should have good stability and remain intact for at least 10 minutes in water.

Table 3 is a general guide to the daily amount of food to feed fish (based on estimated weight) according to the water temperature in production ponds.

Table 3.—*Typical spring, summer, and fall daily feeding schedule<sup>1</sup>*  
(For channel catfish in production ponds stocked with 5-inch fingerlings and harvested as 1.1-lb fish.)

Date	Water temperature at 3 ft	Fish size	Feed allowance	Feed allowance per day <sup>2</sup>	
			Percent of total weight of fish in pond	Stocking rates	
	Degrees Fahrenheit	Pounds	Percent	2,000/acre	3,000/acre
4-15	68	0.04	2.0	1.6	2.4
4-30	72	.06	2.5	3.0	4.5
5-15	78	.11	2.8	6.2	9.2
5-30	80	.16	3.0	9.6	14.4
6-15	83	.21	3.0	12.6	18.9
6-30	84	.28	3.0	16.8	25.2
7-15	85	.35	2.8	19.6	29.4
7-30	85	.42	2.5	21.0	<sup>3</sup> 31.5
8-15	86	.60	2.2	26.4	39.6
8-30	86	.75	1.8	27.0	40.5
9-15	83	.89	1.6	28.5	42.7
9-30	79	1.01	1.4	28.3	42.4
10-15	73	1.10	1.1	24.2	36.3

<sup>1</sup>See page 19 for recommended feeding rates in cooler months.

<sup>2</sup>The feed allowances are based on rations containing 36 percent protein and approximately 2.9 kcal of digestible energy per gram of protein. If feeds of different protein and energy concentrations are used, daily allowances should be adjusted proportionally.

<sup>3</sup>It is risky to exceed 30 lb/acre/day unless water is flowing through the pond or aeration equipment is available.

Scatter feed in 3 to 4 feet of water completely around the pond. Feed at the same time each day when oxygen concentration of the water is highest. This is usually around midday. Trucks with blowers (fig. 13) or other mechanical feeders are desirable for large ponds. Never feed more than 30 pounds per acre per day unless water is flowing through the pond or aeration equipment is available to prevent an oxygen depletion.

Self-feeders are good labor-saving devices for isolated small ponds. Place them so feed will be dropped in 3 to 4 feet of water. Fish learn to bump the underwater release and obtain feed. Avoid overfeeding by putting only the correct amount for 2 or 3 days in the feeder. Without auxiliary hand scattering of feed, self-feeders may cause a wide variation in fish sizes.

Before feeding each day, check the response of the fish by throwing out small amounts of feed; also, check self-feeders to see if they have been used. If fish fail to feed vigorously, something is wrong; stop feeding until you find and correct the trouble.

If you use sinking pellets, check feed consumption by placing a 4- by 4-foot tray on the pond bottom in the feeding area before feeding. Lift the tray slowly an hour after feeding. If all the feed has not been eaten, reduce the amount of food.



*Figure 13.—Mechanical feeders save time and labor by blowing feed directly on the surface of the pond.*

To prevent weight loss and increase disease and parasite resistance, feed catfish held over winter. Self-feeders are helpful in winter, since at this season it is difficult to know when the fish are hungry. When the water temperature 6 inches below the surface is below 45°F, feed every other day at the rate of one-half of 1 percent of the estimated total weight of the fish in the pond. During warm weather feed each day at the rate of 1 percent of the weight when the water temperature is between 45°-60°F. In ponds holding brood fish, stock small forage fish such as fathead minnows (*Pimephales promelas*) or other species to provide protein necessary for egg growth and to keep the males in good condition. If fatheads are not available, feed cut fish or liver.

## Harvesting

Harvesting methods will vary from one fish farming operation to another. Some farmers use a "seine-through" technique that allows for a partial harvest three or four times each year. This method allows the farmer to "top off" the market size fish while the smaller fish pass through the seine and remain in the pond for future growth. Other fish farmers may conduct only one operation for a total harvest at the end of the growing season. This is achieved by seining the entire pond (fig. 14) or by draining the pond and concentrating fish in a harvesting basin.

Catfish ponds should be designed to facilitate harvesting operations. Ponds that have a firm, smooth bottom free from trees and stumps and gradually deepening to a harvesting basin are easily seined. Stretch the seine from bank to bank. A long rope attached to the bottom of each end makes the seine easier to haul. Trucks and tractors with winches are often used to pull long seines. In well-constructed ponds, an experienced seining crew with good equipment can harvest 70 to 90 percent of the fish. Lower the water to concentrate the remaining fish in the harvesting basin.

Carrying fish from a pond to a tank truck is back-breaking labor. Mechanical equipment such as a power hoist mounted on a truck or tractor (fig. 15) makes the job much easier.

Catfish being harvested and hauled are under considerable stress. Fish concentrated during the harvesting operation may suffer from oxygen deficiency and emergency aeration may be necessary to prevent losses. The digestive tract of fish should be empty when they are handled or hauled, so do not feed fish the day before harvest.

Harvest timing is important to the fish farmer. Regardless of the harvesting method used, harvest operations must be coordinated with processing plants, livehaul markets, or other receiving outlets of the fish industry. Evaluate fully the available markets before starting a fish farming enterprise.



*Figure 14.—Seining a pond to harvest fish.*



*Figure 15.—Harvesting is easier with a boom operated from a truck on the levee.*

## Marketing

Markets available to a catfish farmer vary. Selling to a combination of markets often yields the most profit. Some of the markets are:

(1) **Fingerlings.** Fingerlings are priced according to size, quality, and quantity.

(2) **Brood fish.** There is a limited market for high-quality breeders.

(3) **Fee fishing.** Fish are caught with bait and tackle by the consumer who pays a fee, by the pound, for the fish caught. Fee-fishing ponds are usually located near large population centers where there is a demand for this kind of recreation.

(4) **Wholesale.** This market requires large volumes of fish to supply processing plants, cooperatives, jobbers, and many high-volume outlets such as the live-haul industry. Farmers may sell fish at a lower price per pound to such markets, but their marketing costs are usually lower than for retail marketing.

(5) **Retail.** This market is usually for small-volume sales. Fish are sold live or dressed. Both marketing costs and sale prices are usually higher for small lots.

## Problems and Treatments

### Oxygen Deficiency

Oxygen deficiency, one of the most common problems facing the fish farmer, can cause fish kills and induce disease and parasite infections. Catfish may fail to feed when oxygen levels drop to 2 ppm or lower.

A number of environmental conditions may cause oxygen deficiency. Excessive plankton blooms are responsible for most of the dissolved oxygen problems in fish culture. Such blooms are common in ponds where fish are being fed at high rates. While it is true that phytoplankton and other forms of algae produce oxygen during bright, sunny days, even to the point of supersaturating the water, the same algae population consumes oxygen at night and during periods of extended overcast. Intensive aquaculture producers strive to maintain moderate plankton populations for their beneficial values, oxygen production, and fish food value. If a heavy plankton bloom suddenly changes color (usually from green to brown), an oxygen shortage can be expected 1 to 3 days later. Oxygen deficiency can also result from unfavorable weather. Problems can occur on hot, cloudy, still days or on days with unusually high winds and cold rainfall.

A fish farmer must be prepared to correct oxygen deficiency quickly. The most effective method to correct pond waters temporarily deficient in oxygen is to use mechanical aerators or to introduce oxygen-rich water from another source. Aeration devices



range in size and efficiency from the small spray-type surface aerators (fig. 16) to the larger and more powerful Crisafulli pump-sprayer (fig. 17) or the paddlewheel aerator (fig. 18). The last two are generally powered by farm tractors and are the most effective devices to use in emergencies.

Some ways to detect and prevent oxygen depletion follow:

(1) Check the pond at daybreak each day during warm weather, since oxygen levels are lowest early in the morning. If fish are at the surface gasping for air, start aeration at once. If your water source is a well, pump fresh water into the pond and spray it into the air or splash it over a baffle or through a screen. You can also use a pump to recirculate pond water. Take water from near the surface and spray or splash it back into the pond.

(2) Fish do not feed well in oxygen-deficient water. On hot, humid, cloudy days, be especially cautious. Start with a small amount of feed. If the fish fail to feed, an oxygen shortage may be developing. Discontinue feeding until the oxygen deficiency is corrected. Resume daily feeding with small amounts until the fish again feed vigorously.

(3) From early spring to late fall check the water daily with an oxygen test kit or meter, especially during hot, cloudy, still weather. Any time the oxygen is below 2 ppm, be prepared to take remedial action.

(4) Low night-time oxygen concentrations can be predicted in advance by measuring the dissolved oxygen concentrations at dusk and again 2 to 3 hours later. The dissolved oxygen concentration at later hours can then be estimated by plotting these values versus time on a graph (fig. 19). This procedure allows the fish farmer to prepare for emergency aeration in advance.

(5) Recent research and experience in catfish pond management indicate the problems of oxygen depletion and thermal stratification are best solved by prevention rather than attack after problems occur.

## **Undesirable Fish**

Undesirable fish are a common problem in fish farming. They can be reduced by:

(1) Draining and drying each pond after harvest. If the pond cannot be completely dried before stocking, treat the water with a fish toxicant to be sure no undesirable fish are carried over. Before restocking, make certain that no fish toxicant remains in the water.

(2) Using well water instead of surface or spring water.

(3) Using a turndown drainpipe. When drainpipe is upright, fish cannot enter the pond unless the flow of water is reversed.

(4) Filtering surface water, if it must be used, through a saran or fiberglass screen.



*Figure 16.—Spray-type aerators such as this are powered by electric motors. Photo courtesy of Alabama Cooperative Extension Service.*



*Figure 17.—Crisafulli pumps and sprayers are operated by tractor PTO units.*



Figure 18.—Paddlewheel aerators are powered by electric motors or tractor PTO units. Photo courtesy of Alabama Cooperative Extension Service.

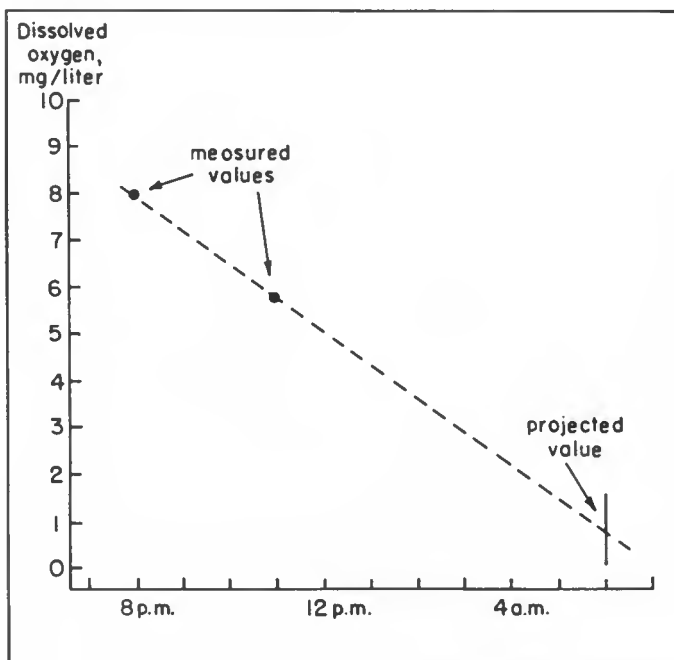


Figure 19.—Measured and projected nighttime decline in dissolved oxygen concentration in fish ponds. Source: Boyd et al. 1978.

(5) Stocking bass to prey on undesirable species fish. Stock bass equal or nearly equal in size to the catfish at the rate of 50 to 100 per acre.

(6) Using an overflow pipe, a screened overfall, or vertical drop in the spillway in ponds receiving enough surface drainage to cause spillway action.

## **Muddy Water**

Although catfish can be grown in muddy water, productivity is lowered because natural food organisms are scarce. Ways to avoid muddy water include proper pond design and construction and maintaining good grass cover on banks, dams, and levees. Suspended clay is a common cause of muddy water in catfish ponds, particularly those receiving runoff water. It may be necessary to remove the turbidity so that light will penetrate deep enough in the pond to support the growth of free floating algae (phytoplankton), a natural fish food and oxygen producer. Ponds can be cleared, at least temporarily, by adding materials that cause suspended clay particles to aggregate (floc) and settle to the pond bottom. The most effective additive is filter alum, widely used in water treatment plants to clarify drinking water. A treatment rate of 25 to 30 ppm of alum will clear most muddy waters. As a note of caution, alum (aluminum sulfate) has an acid reaction in water that in turn lowers pH and reduces total alkalinity. Therefore, to prevent harmful effects on fish when treating for clay turbidity with alum in ponds with low alkalinity (less than 20 ppm), simultaneously add hydrated lime (calcium hydroxide) at the rate of 0.4 ppm for each part per million of alum added.

Agricultural gypsum can be used to remove clay turbidity. Although it is less effective than alum it has a neutral reaction in water. Scatter gypsum on the pond surface using 200 pounds per acre if the water is only slightly turbid. As much as 800 pounds per acre may be needed in very muddy water. Repeat treatments at 7- to 10-day intervals until the water clears.

Organic matter may be added to muddy ponds to remove clay turbidity; however, caution must be taken in hot weather because decaying organic matter may cause serious oxygen depletion. Organic matter may be applied in several forms. Bales of hay (7 to 10 per surface acre) are effective. Break the bales into blocks and place them in shallow water along the edge of the pond. Repeat treatments after 10 days if necessary. Another technique using organic matter is to scatter a mixture of 75 pounds of cottonseed or soybean meal and 25 pounds of superphosphate per acre on the pond surface. Repeat treatment after 10 days if necessary.

## **Waterweeds**

Proper pond design and water quality management will generally prevent growth of waterweeds. Shallow water allows waterweeds to get a start. Good pond design provides a 2½- to 3-foot minimum depth. Fill ponds with water as soon as possible to prevent excessive weed growth and erosion.

Waterweeds can be controlled by the shading effect of phytoplankton populations. Early fertilization to stimulate phytoplankton growth is appropriate in the South where fish winterkill (fish mortality from oxygen depletion resulting from ice and snow cover on ponds) is not a problem.

A few herbicides have been approved for aquatic weed control under certain conditions. Use such chemicals according to the recommendations and restrictions stated on the label. If the label does not include instructions for a proposed use, such as aquatic weed control in fish ponds, the product has not been registered for that purpose and should not be used. Improper use may result in the fish being condemned for human consumption.

## **Disease and Parasites**

Uncontrolled fish diseases and parasites can be a serious problem. Preventive management and early detection are required for their proper control.

Watch for changes in normal fish behavior, for reduced vigor, or for failure to feed. Lesions or sores are visible effects of parasites. If a disease or parasite is evident, consult a fisheries biologist or fish pathologist for diagnosis and recommended treatment if necessary.

Before stocking, treat fish from outside sources for disease and parasites. Use only approved chemicals and no more than one at a time. Observe the same precautions for chemicals used to treat fish diseases and parasites as for herbicides. Use of unapproved chemicals could result in the fish being condemned for human consumption.

## **Shock**

Catfish are extremely sensitive to sudden changes in water temperature. When moving catfish from one body of water to another, raise or lower the temperature of the water in the container in which they are transported to approximate that of the water into which they are to be placed. Temper the water in the container by slowly mixing water from the receiving pond with that in the container. If there is 10°F difference in temperature, the mixing should take about an hour. Aeration may be necessary while tempering the water.

## **Predators**

Newly hatched fry, especially in brood ponds, are sometimes eliminated by predaceous insects. To control insects, pour a mixture of 1 quart of motor oil and 2 to 4 gallons of diesel fuel per surface acre on the surface of each brood pond just before or immediately after egg laying. Repeat if necessary. Pour the oil mixture on the pond when there is a slight breeze that will carry it across the surface. This mixture will not harm the fish.

Water snakes and adult frogs prey on small catfish and should be eliminated. Keeping grass mowed around edges of ponds makes the area less attractive to snakes.

## **Off-flavor**

Blue-green algae and some fungi and bacteria are known to produce a compound that causes off-flavor, which is a serious problem in food-fish farming. Fish processors generally require a check for off-flavor. Before harvesting a pond, sample several fish to check for flavor. If any off-flavor is detected, delay harvesting until it has dissipated. Off-flavors occur most often in late summer when water temperatures are high, the largest amount of feed is being used, and the algal blooms are dense; it also occurs frequently in cool weather during spring and fall.

Control of the off-flavor problems in ponds is in the research and development stage. At present, the best known remedy for off-flavor is to place fish in an environment free of organisms that produce off-flavor. Tests showed that off-flavor dissipated when affected fish were held in clean water for 7 to 10 days at 75°F, or for 10 to 15 days at 62°F, depending on the flavor intensity. Off-flavor may persist from several weeks to several months in production ponds harboring the organisms that produce off-flavor compounds. Consult a fish biologist for the latest treatment technologies.

## **Costs of Catfish Farming**

Many of the costs in catfish farming can be determined prior to starting the enterprise. That is the time to examine the alternatives in size and kind of enterprise and possibilities for expansion.

### **Construction of Facilities**

Pond construction is a major expense. The kind of pond built may be the most important decision made in catfish farming. Costs depend on the kind of equipment used, the cost of moving soil, and the size and shape of the pond. Small rectangular or odd-shaped ponds are more expensive to build than large square ponds. Pond

maintenance is a recurring cost. Similar costs are involved with raceways, holding vats, hatcheries, etc.

### **Water**

Water is another major cost item. Wells, which are generally preferred as a source, vary in cost according to size, depth to water table, geologic structure, and other factors. A 6- or 8-inch well that produces 1,000 to 1,500 gallons per minute usually provides enough water for 40 acres of ponds.

### **Fish**

Fish for stocking are either produced on location or purchased. If produced on location, spawning pens, hatching troughs, holding vats, etc., must be constructed. Water delivery systems and hatchery buildings are also a cost.

### **Feed**

Feed costs vary widely, depending on volume purchased, distance shipped, and type (floating or sinking). About 3,000 pounds of feed are needed to produce 2,000 pounds of fish.

The information in this publication is somewhat generalized and the technical information provided on all aspects of catfish culture is not sufficiently detailed to answer all questions that may arise. Before establishing a commercial fish farming enterprise, specific site assessments are recommended to evaluate accurately the catfish growing and marketing potentials resulting from the wide variation of environmental, social, and economic factors affecting aquaculture. The farmer should analyze costs for taxes, labor, pond construction and maintenance, water supply development (including pumping and quality control), fish for stocking ponds, and costs for feeding, harvesting, and marketing.

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